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U. S. DEPARTMENT OF AGRICULTURE,

FOREST SERVICE—Circular 121.

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(IN COOPERATION WITH THE U. S. DEPARTMENT OF COMMERCE AND LABOR, BUREAU OF THE CENSUS, S. N. D. NORTH, DIRECTOR.)

WOOD USED FOR DISTILLATION IN 1906.

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Previous to 1905, statistics upon the production of lumber and timber products were collected by the Bureau of the Census in connection with the decennial and quinquennial censuses of manufactures. To satisfy the urgent demand for more frequent reports on these important products, the Forest Service collected statistics of the production in 1905. In 1906, the Bureau of the Census and the Forest Service arranged to cooperate in the preparation of annual statistics of forest products.

The collection and compilation of the statistics of production in 1906, therefore, have been under the direct supervision of W. M. Steuart, Chief Statistician for Manufactures, and J. E. Whelchel, Expert Chief of Division, on the part of the Bureau of the Census; and R. S. Kellogg, Chief of the Office of Wood Utilization, and H. M. Hale, Forest Assistant, on the part of the Forest Service.

WOOD USED FOR DISTILLATION IN 1906.

Since the distillation of wood is divided into two distinct branches, the distillation of hardwoods and the distillation of softwoods, each branch of the industry is dealt with separately in this circular.

HARDWOOD DISTILLATION.

The statistics of hardwood distillation are based upon reports received from 86 plants, while those for 1905 [a] were the result of reports from 67 plants. This does not mean that there has been a large increase in the number of plants in operation, since the statistics for 1905 did not cover the field completely. For this reason no comparison of the production of the two years has been attempted.

Table 1 shows the quantity and value of the hardwood used for destructive distillation in 1906. The unit of measure is the cord of 128 cubic feet of rough wood. It is impracticable to separate the body wood and limb wood or show the exact quantities of each of the different hardwoods which are used. Beech, maple, and birch combined furnish practically all of the raw material used, although some oak and other hardwoods enter into the total.

TABLE 1.—*Wood used in hardwood distillation by States in 1906.*

State.	Number of plants.	Wood used.	Value.	Value per cord.
		Cords.	*Dollars.*	*Dollars.*
Michigan	12	541,119	1,626,750	3.01
New York	20	91,380	301,296	3.30
Pennsylvania	50	390,752	1,395,637	3.57
All others [b]	4	121,645	392,740	3.23
Total	86	1,144,896	3,716,423	3.25

[a] Forest Service Circular 50, Wood Used for Distillation in 1905.
[b] Missouri, Maine, and Wisconsin.

The average cost of wood is highest in Pennsylvania and lowest in Michigan. While both of these States are well supplied with raw material for this purpose—beech, birch, and maple—Pennsylvania, being an older and more thickly populated State, offers a readier market for wood, and the consequence is it brings a higher price.

Table 2 gives the quantity and value of products obtained from the distillation of hardwood. It will be seen that the value of the charcoal, alcohol, and acetate of lime produced are nearly equal.

TABLE 2.—*Products of hardwood distillation by States in 1906.*

State.	Charcoal.		Crude alchohol.		Gray acetate.		Brown acetate.		Tar and oils.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Bushels.[a]	*Dollars.*	*Gallons.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dolls.*	*Galls.*	*Dolls.*
Michigan	21,688,170	1,366,538	2,956,739	998,939	15,064,508	300,916	3,172,670	31,245	150,000	15,000
New York	3,075,673	212,072	871,036	302,783	13,860,892	269,086	3,264,281	46,188	.....	.....
Pennsylvania	15,316,826	1,010,558	3,467,167	1,192,921	61,859,097	1,366,500	523,982	8,344	100,610	4,877
All others[b]	5,577,052	376,772	576,552	181,548	5,592,000	80,829	.....	.....	.....	.....
Total	45,657,721	2,965,940	7,871,494	2,676,191	96,376,497	2,017,331	6,960,933	85,777	250,610	19,877

[a] Bushel equivalent to 20 pounds. [b] Missouri, Maine, and Wisconsin.

Michigan, Pennsylvania, and New York are the principal States in the destructive distillation of hardwoods. Michigan leads both in quantity of wood used and in charcoal produced, while Pennsylvania ranks first in the production of crude wood alcohol and gray acetate of lime. (Tables 1 and 2.) This fact is the result of conditions under which the wood is carbonized, rather than any quality of the wood itself. Michigan uses most wood, but obtains from it a very low average yield of both acetate of lime and alcohol but a fairly large amount of charcoal. Wood alcohol and acetate are by-products that can be saved in their entirety only by the use of the most improved processes of distillation—that is, the use of air-tight retorts and the carbonization of the wood by indirect application of heat.

Charcoal, on the other hand, can be obtained in large quantity by almost any process of carbonization. At present in Michigan most of the wood is carbonized in kilns, in which it is placed and fired directly. Under these conditions 4 to 6 gallons of wood alcohol per cord and but a small proportion of acetate can be saved. The production of charcoal per cord, on the other hand, is maintained at nearly its maximum.

In Pennsylvania opposite conditions obtain, retort and oven plants being employed almost exclusively, so that the production of wood alcohol shows an average of 8 gallons per cord, and acetate 160 pounds. Charcoal, however, is practically the same as in Michigan.

Table 3 summarizes the figures given in Table 2 and, in addition, shows the average value per bushel, gallon, or pound of the products.

TABLE 3.—*Quantity and value of the products of hardwood distillation in 1906.*

Product.		Quantity.	Total value.	Average value.
Charcoal	bushels	45,657,721	$2,965,940	$0.06
Alcohol, crude	gallons	7,871,494	[a]2,676,191	.34
Acetate, gray	pounds	96,376,497	2,017,331	.02
Acetate, brown	do	6,960,933	85,777	.01
Tar and oil	gallons	250,610	19,877	.08
Total		.....	8,020,971	.....

[a] Estimated.

Of all products charcoal has the greatest total value, followed by wood alcohol, gray and brown acetate of lime, and tar and oil, in the order given. The average price obtained for crude wood alcohol in 1906 was 34 and a fraction cents per gallon. In New York charcoal brought the highest average price and in Missouri the lowest, though in no case did the price exceed 7 cents per bushel. All refined wood alcohol reported has been reduced to crude wood alcohol of 82 per cent test.

Calculations based on Tables 1 and 2 show that Michigan and Pennsylvania have an average production of charcoal per cord of wood of about 40 bushels. New York ranks lower than either Pennsylvania or Michigan, having an average production of less than 34 bushels per cord. In computing the number of bushels of charcoal, a standard of 20 pounds per bushel has been used.

PINE DISTILLATION.

While in hardwood distillation the chief products are wood alcohol, charcoal, and acetate of lime, in pine distillation they are turpentine, tar, and charcoal, though the last is comparatively unimportant. Operations at present are confined almost wholly to southern pines. The States of North Carolina, South Carolina, Georgia, Florida, and Alabama furnish practically all of the turpentine obtained in this manner. It is interesting to note, however, that operations have been started upon the Douglas fir of the Pacific coast and the Norway pine of the Lake States.

PROCESSES EMPLOYED.

It must be borne in mind that the figures given for the products of pine distillation are the results of a combination of products, obtained by two distinct processes of distillation, destructive distillation and

steam distillation. The former process is somewhat similar to the destructive distillation of hardwood, in that the wood is carbonized completely and the oils are driven off in this way. The chief products obtained are turpentine, tar, charcoal, and oils.

The other process is known as steam distillation. Briefly, it consists of reducing the wood to chips by mechanical means and cooking it with live steam. The products contained in the wood are distilled with the steam and come off readily. The wood, however, is not carbonized as in the other process.

The chief products of distillation by this process are turpentine and heavy oils. Turpentine produced in this manner is, when properly refined, about equal to gum turpentine and superior in some respects to turpentine obtained by destructive distillation of pine.

Table 4 shows the quantity and value of softwood distilled in 1906, as reported by 33 plants. The total amount used was 50,234 cords, valued at $129,358, or an average value of $2.58 per cord. The highest average price per cord, $3.03, was in North Carolina; the lowest average, $1.73, was in Florida.

TABLE 4.—*Wood used for pine distillation in 1906, by States.*

State.	Quantity.	Average value per cord.	Total value.
	Cords.		
Alabama	3,236	$2.81	$9,098
Florida	10,100	1.73	17,515
Georgia	14,986	2.51	37,661
North Carolina	16,332	3.03	49,564
South Carolina	2,972	2.64	7,837
All others[a]	2,608	2.95	7,683
Total	50,234	2.58	129,358

[a] Louisiana, Michigan, Minnesota, and Washington.

Table 5 shows the quantity and value of the products of pine distillation in 1906.

TABLE 5.—*Quantity and value of the products of pine distillation in 1906.*

Product.	Quantity.	Total value.	Average value.
Turpentine ... gallons	503,427	$238,612	$0.47
Tar ... do	648,120	64,368	.10
Charcoal ... bushels	791,887	44,381	.06
Oil of tar ... gallons	125,008	17,429	.14
Pyroligneous acid ... do	305,000	15,380	.05
Total	.....	380,170	.....

Table 6 itemizes, by States, the products of the distillation of pine.

TABLE 6.—*Products of pine distillation, by States, in 1906.*

State.	Turpentine.		Tar.		Charcoal.		Oil of tar.		Pyroligneous acid.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Gallons.	*Dollars.*	*Gallons.*	*Dollars.*	*Bushels.*[a]	*Dollars.*	*Galls.*	*Dollars.*	*Gallons.*	*Dollars.*
Alabama	43,360	20,106	150,000	10,500	80,000	8,000	.....	.....	200,000	10,000
Florida	97,600	49,570	257,600	30,912	112,500	6,750	.....	.....	.....	.....
Georgia	140,375	71,637	30,070	3,511	99,000	6,688	56,538	10,301	13,000	780
North Carolina	148,986	65,785	105,600	10,560	411,442	17,811	28,970	2,528	11,000	550
South Carolina	33,242	13,902	69,000	5,100	25,000	1,500	39,500	4,600	81,000	4,050
All others[b]	39,864	17,612	35,850	3,785	63,945	3,632	.....	.....	.....	.....
Total	503,427	238,612	648,120	64,368	791,887	44,381	125,008	17,429	305,000	15,380

[a] Bushel equivalent to 20 pounds. [b] Louisiana, Michigan, Minnesota, and Washington.

Florida leads in the production of tar and North Carolina in the production of turpentine. The extremely varying amounts shown in the average quantity of products obtained in the different States show clearly that distillation methods are not yet perfected and that considerable quantities of some of these products are not saved. The charcoal product is strikingly variable, because in destructive distillation charcoal is a product of importance, while the extraction of turpentine and other oils from pine wood by steam distillation does not carbonize the wood, so no charcoal is obtained.

Table 7 shows the quantity and value of wood alcohol exported from 1902 to 1906. The quantity exported nearly doubled from 1902 to 1904, while the average value decreased from 54 cents per gallon in 1902 to 49 cents per gallon in 1904. In 1905 there was an unimportant reduction in the amount exported, while the price increased from 49 cents to 55 cents. In 1906 the quantity exported shows a reduction of about one-third from 1905, and the price increased to approximately 60 cents per gallon.

TABLE 7.—*Quantity and value of wood alcohol exported, 1902–1906.*

Year.	Quantity.	Value.	Average value per gallon.
	Gallons.		
1902	626,925	$338,619	$0.54
1903	833,629	452,892	.54
1904	1,194,466	585,359	.49
1905	1,097,451	603,385	.55
1906	780,222	466,467	.598

Approved:

JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., *October 5, 1907.*